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ABSTRACT

New ways are needed for a citizen to participate actively in meaningful discussions of political issues. Telephone and cable television (CATV) facilities may help bring this about. For example a group of representatives could discuss some proposal for an hour and it could be broadcast over CATV or even radio several times during the day. Citizens who wish to discuss the issue could notify a coordinating center and could be assigned to small groups using conference telephone facilities. Elements needed for such experiments are (1) a broadcasting facility, (2) a means of receiving, processing and displaying audience feedback, (3) a way of receiving and rebroadcasting audio signals from the audience, (4) interconnection of large numbers of people into small groups. Although all of this could be done using the telephone system, some modifications of telephone equipment would be required. CATV could be used for the same purposes, with the modifications built in when the cable is laid. (MG)

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TECHNOLOGY TO FACILITATE CITIZEN PARTICIPATION IN GOVERNMENT

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Abstract

The overall philosophy for a system enabling citizens to participate meaningfully in governmental decision making is discussed. It is argued that facilities are needed for remote conferencing among citizens and for remote polling. Implementations, utilizing to a maximum feasible extent telephone and CTV systems, are suggested, along with indications as to difficulties, useful elaborations, and other uses for the added equipment.

1. Introduction

On an Israeli kibbutz, the members (usually numbering in the hundreds) assemble weekly in their meeting hall to discuss community affairs and to make policy decisions. Every resident is entitled to participate both in the discussion and in the voting.

This is probably the purest form of democracy practiced in the world today, altho it should be noted that it operates mainly in the realm of local government and industry. Other examples of such direct government by the people include the New England town meetings and, to a lesser degree, the assemblies of ancient Athens.

Where communities exceed a few thousand residents or are geographically dispersed, it is obviously impractical for all citizens to gather together at reasonably short intervals to transact public business. This is one reason modern democracy operates through parliaments of elected representatives.

For various reasons there is considerable dissatisfaction with this system. This is particularly true where each representative has a large constituency so that the average citizen has only a miniscule opportunity to affect the policies of the government. It is often the case, particularly on the national level, that the distribution of seats in the parliament corresponds poorly to the political spectrum of the citizenry. Systematic gerrymandering is frequently used to amplify this effect.

A current example of an apparent failure of representative democracy is the fact that long after it has become evident, thru numerous public opinion polls and local referenda, that most Americans

desire an immediate end to US involvement in the Indochina War, the House of Representatives has not even come close to approving a resolution along these lines.

The complexity of our civilization, in part a reflection of the complexity of modern technology, is often cited as a partial explanation of the increasing distance between the citizen and his government. It has also been suggested [Ref. 1-3] that technology can be used to overcome to a large degree the barriers that now isolate the citizen from the decision making process. The project outlined here, called MINERVA, constitutes an attempt to do this via an interdisciplinary effort involving social scientists and electrical engineers. It is a continuation of the work* described in Reference 1, and is still in its early stages.

2. Basic Goals and Strategy

The objective of this research is to make it possible for the citizen to participate actively in meaningful discussions of political issues and to have his opinions taken into account when decisions are made. A vital assumption underlying the project is that first a person must have an opportunity not only to receive information and to hear arguments on an issue, but also to discuss

* Initiated by Amitai Etzioni and Eugene Leonard

the issue himself with other citizens. Following such discussions he should then be able to cast a vote expressing his view.

Without the discussion, the subsequent vote is likely to be uninformed and inconsistent with other views held by the same individual. The wording of the question will assume disproportionate significance, perhaps deliberately evoking some particular emotional response. An exchange of views with others is an effective way to develop a well founded opinion.

On the other hand, the dialogue process is meaningless unless it is a prelude to a poll that will influence the final decision. This influence might range from a rather complete sampling of the views of a legislator's constituency, which might be expected to have a major effect on his vote, to a direct referendum that would in itself be decisive.

Thus it is necessary to develop means for facilitating <u>both dialogue and polling</u> among large groups of people. In order to maximize participation, citizens should be able to take part without leaving their homes. Furthermore, if such systems are to be feasible in the near future, they should utilize existing facilities to the greatest extent possible, with minimum requirement for additional equipment. Finally, to the extent that additional hardware is necessary, it is desirable that it be useful for other purposes as well.

Two communications systems with at least potential 2-way capabilities now reach into an appreciable number of American homes: the telephone system and cable television (CTV). Since the latter is a broadband system, it offers the greatest opportunities for use in a MINERVA system. By contrast, the telephone system is both narrow band and is, in many areas, already heavily engaged in fulfilling its primary function. However, at this time, CTV reaches only about 10% of American homes, and is not expected to reach 50% until the end of this decade [4].

The penetration of the telephone is already about 95%. It should also be noted that in some communities, CTV penetration is very high, and that CTV is not expected to reach certain others (characterized by widely scattered residences) for well over a decade (if at all).

The above considerations have led to the conclusion that the MINERVA project should consider using both CTV and telephone systems, independently and jointly. Over-the-air broadcasting including AM, FM, and Citizen Band radio, as well as VHF and UHF television must also be considered under certain circumstances.

Before discussing the technical problems in more detail, it might be useful to indicate some of the possible modes of operation.

(1) A group of local officials and community representatives discuss some proposal for an hour, and this might be broadcast (TV,

CTV or even radio) to the community, possibly several times during the day or evening. Citizens who wish to discuss the issue then key in this fact (using a simple terminal associated with their telephone or CTV set) perhaps indicating their tentative positions. Such data is collated by computer and remote conferences are then set up among groups of perhaps 10 citizens. The next day, again using their terminals, the citizens cast votes on the proposition.

(2) A national issue is discussed at local meetings throughout the country. (These might involve hundreds of people assembled in auditoriums or participating from their homes via CTV and telephone facilities.) At each meeting, the participants agree on several brief statements that cover the range of opinions of those present. These are taped and the statements at each meeting in a particular city are broadcast in that area. Perhaps after some small group conferences as in (1) the citizens at home, using their terminals, select a subset of the statements they have heard. The voting method is chosen so as to maximize the range of statements selected. This process is then iterated over wider and wider constituencies. On sufficiently important issues, it might be recycled to the basic level meetings one or more times. Eventually a set of statements is broadcast to the entire nation. After further discussion, a poll is taken on the issue.

(3) Each congressman appears monthly with members of opposition parties on broadcasts to his constituents. Each broadcast is

preceded (say on the previous day) by a brief program stating the issues currently before the congress and the recent voting record of the congressman. Constituents then have a chance to discuss these issues in small groups as in (1). At the end of the congressman's broadcast, questions are phoned in by constituents and broadcast along with his responses. Citizens can vote from their terminals as to whether they want more discussion on each question and on whether they approve or disapprove of the responses.

The above sketches are not intended to define a specific proposed system (we have not reached that stage) but simply to indicate some of the possibilities. Further experimentation at various levels will be necessary in order to arrive at satisfactory modes of operation.

The key features necessary for our purposes are:

a) broadcasts (audio and preferably video as well) to a selected home audience.

b) the reception, processing and display of discrete valued responses from the audience.

c) the reception and rebroadcasting of audio signals from members of the audience.

d) the interconnection of large numbers of people into small groups for dialogues from the home.

e) the reception and tallying of responses from large numbers of people over a wide area.

Means for implementing these features are discussed below.

3. Small Group Dialogues

Conventional telephone service involves the interconnection of two stations. If additional stations are added to the circuit via simple direct connections, a loss of signal strength occurs due to the increased load, and the noise level increases as a result of the additional inputs.

In order to overcome these difficulties, a device known as a conference bridge is used [5]. Each station involved in a multi-party, or conference, call (the term tele-conference is also useful) is connected to an input, or port, of the bridge. Signals entering from each port pass thru a switched gain amplifier which amplifies the signal only when its level is high enough to indicate that it is in active use. Thus only signals on currently active channels are amplified and hence the problems of signal strength and noise level are both resolved.

There are 30-port conference bridges now in commercial service. But the services of a special operator are required to call the conferees and set up the connections to the bridge. Hence this is a relatively expensive and infrequently used type of call.

The electronic switching system (ESS) type telephone offices [6], the type currently being installed, have the capacity for subscriber dialed conferences of up to four stations. No bridge is used; a certain degredation of signal quality is tolerated. There is no serious obstacle to providing a capability for subscriber dialed conferences using the full capacity of existing bridges.

It is also possible to locate the bridge outside the telephone central office with a regular phone line for each port. A commercial enterprise called Teleses ions [7] uses such an external conference bridge to set up regularly scheduled telephone meetings among groups of people with special interests (stamp collectors, gourmets, etc.). (Note that when the bridge is external to the central office, twice as many outside lines must be used for each conference.)

Assuming that audio conferences can be set up using the telephone system, how effective are they likely to be for the purposes outlined in the previous sections? In face to face meetings, communication occurs in a variety of ways other than vocal. Participants express feelings thru gestures, facial expressions, posture etc. They indicate a desire to speak by raising hands, and acknowledge such requests by nodding heads. Persons other than the speaker may make non-verbal sounds to indicate approval or disapproval.

Clearly something is lost when all such non-verbal cues are shut out. The addition of pictures to the audio signal [8] would restore a substantial part of this information. However, altho video conferences are perfectly possible, the expense of providing such a facility on a broad scale is likely to be very high in the forseeable future [4]. The telephone company does not anticipate any significant penetration of picturephone into American homes during the next decade.

Fortunately, there are indications that simple audio conversations may be adequate [9]. Our initial experiment with 8-person tele-conferences tend to indicate that they can be effective. The Telesessions people claim that an important advantage of a phone conference over a face-to-face conference is the absence of the possibility for distracting side remarks to neighbors around a table [7]. Such factors must however be handled very cautiously, since a set of constraints that facilitates a conference of one type, among one group of people, may be a hindrance under other circumstances.

Some of the functions of non-verbal cues seem particularly important, particularly when the conference participants are strangers. For example, it would be very useful to allow requests for the floor to be registered without interrupting the current speaker.

In order to implement such a feature, an additional subchannel must somehow be superposed on the standard telephone channel. A prime candidate is the touchtone system [10] currently used for subscriber signaling to the central office. Pairs of tones not harmonically related are used for each of 12 (extendable to 16) signals. These tones range from about 700 to 1600 hertz, near the middle of the telephone range, which is generally taken as 200-3600 hertz. Touchtone signals can be sent and reliably decoded while speech signals are present in the channel. Furthermore it seems feasible to attenuate the touchtone signals to an acceptably low level at the telephone receivers by means of carefully designed filters.

Thus we might imagine each subscriber being equipped with a standard touchtone telephone set (supplemented by touchtone filters in the receiving circuit) and a touchtone detector controlling a panel of lights. Assuming appropriate circuitry at the bridge, it can now be arranged for conferees to call for the floor by depressing an appropriate touchtone button for at least one second, whereby a light corresponding to that conferee on the panels of all the conferees will go on and remain on until cancelled. Flashing lights might be used to convey other kinds of information. A number of variations are possible allowing indications as to who is currently speaking, who wishes to speak, expressions of approval, and expressions of disapproval. A pair of panel lights might be desirable for each touchtone button, as well as a numerical display.

Another feature that might be useful in a tele-conference is a "gavel" that a chairman might use to over-ride the other participants in chaotic situations. This might be implemented as an unfiltered touchtone signal.

A series of experiments designed to determine the usefulness of such supplements to the tele-conference channel is now being carried out. (At this point, the desired effects are being produced, not by touchtone signals, but by a simpler multi-wire set-up.)

Since the conferences of particular interest in this project are among arbitrary groups of citizens, there are no natural candidates for the chairmanships. It is therefore of interest to explore the possibility of extending the above described system

so as to automate the key function of the chairman, namely assigning the floor in an orderly manner. This might be accomplished as follows:

Within a conference bridge, there are distinct circuits for transmitting and receiving from each port. Hence it is possible to independently allow or disallow speech transmission from each participant by simply operating relays. Overall control of this operation can be assigned to a small computer (time shared among many bridges) which receives inputs from touchtone decoding circuits at the bridge and from a real time clock.

As participants request the floor (by appropriate touchtone signals) they can be placed on a queue in computer storage and the floor can be assigned in order of these requests. Time constraints can be placed on the current speaker as a function of the current number of requests for the floor and perhaps explicit signals from the other participants signifying that they would or would not like to have him continue. A warning signal might precede the cutting off of a speaker by some suitable interval. A feature permitting open or secret balloting among the conferees would not be difficult to implement in this environment. After the initial experiments with the minimal system, the concept of the automated chairmanship will be explored in detail.

A significant aspect of the systems discussed above is that, apart from the process of setting up the calls, no burden is placed on the central office apparatus. That is, all of the signalling involving conferees and the bridge is originated and interpreted

by equipment associated with either the bridge or the subscriber stations. One important consideration is the cost of the touch-tone detectors and filters that are needed at subscriber locations. At present, such equipment is quite expensive. It is anticipated (and this assumption must be examined carefully at some point) that appropriate redesigns and the use of low cost integrated circuits can drastically reduce the costs.

A more basic problem may be the loads imposed on telephone systems by large numbers of tele-conferences being in progress or being set up within short time intervals (say within two hours after a tele-cast forum). These loads fall on the central office control unit, which is burdened only during the set-up and take-down periods, and on the switching network and conference bridges, which are burdened for the duration of the conference. The former problem is perhaps less serious since the detailed operations required to set up the conferences can be originated from the central office at moments convenient to its control unit. With respect to the other factors, they amount to an added service being performed by the telephone system, and if it is not possible to spread out the conference load so as to avoid peak hours, appropriate expansion of telephone system plant may have to be reckoned as part of the cost of a MINERVA system.

The possibility also exists of audio conferences being implemented with CTV facilities. This can be done with conventional frequency division CTV [4] by allocating audio channels as well as video channels, using one channel to carry the audio signals from

conferees to head end, and a second channel to broadcast the signals back from the head end to the conferees. Any number of subscribers could join such a conference by simply tuning in. About 600 such channel pairs could be provided in place of one video channel.

In a switched cable system [4], similar conferences can be set up by connecting conferees who dial a specified number to a circuit similar to a telephone conference bridge.

For both types of CTV systems, touchtone signals could be used to provide supplementary features as discussed in connection with conferences using telephones.

4. Polling

Quantitative readings of the views of a group of people on a specific issue are conventionally obtained in many ways, which differ in precision, time required, openness, protection against fraud, and totality of participation. These include applause, voice vote, show of hands, secret ballot (voting machine or paper ballot) and roll call. Most of these can involve either the entire group or a random sample. Other variations include multiple voting in which a series of choices can be listed in order of preference.

An important goal of the MINERVA project is to develop practical methods for implementing a variety of remote polling methods. As in the case of conferences, both telephone and CTV systems will be considered as vehicles.

The convergence at a single point of responses originating at a large number of residences is a process that is the inverse of broadcasting. An appropriate term might be incasting.

Difficulties arise when the entire process is to be accomplished over a short time interval, since the communications channels to the central point may be inundated. This is a fundamental problem when a narrow band system, such as the telephone system, that is designed to serve a rather different function is used. If, for example, during some one minute interval 25% of the telephones in a given central office district were taken off hook for the purpose of dialing in votes, the central office would be unable to cope with the situation, and most subscribers would not even get dial tone.

The problem is most acute when the data units are incasted to the central point asynchronously, with the collecting unit having no control over the timing. Since one cannot expect voters to stand by waiting for a signal to vote, the solution must involve the storage of information at the voter's home terminal. This allows the voter to cast his vote (by pushing some buttons) at his own convenience (within some specified interval). The information describing his vote is stored in some simple, electrically readable form and then, upon receipt of an appropriate interrogation signal from the collecting unit, it is transmitted to that unit which is in a state suitable for processing it.

It would be possible to realize a polling system along the above lines by interrogating telephone lines of subscribers thru

the central office switching network. This would be a practical scheme in cases where the number of votes that had to be tabulated per minute did not impose an excessive burden on the central office control circuits. Note that, unlike the case of conference calls, there is no danger of overloading the network itself because the holding time for each interrogation can be a fraction of a second. Where the added traffic would be excessive, and it is quite easy to imagine such situations, additional equipment is necessary [11].

This might consist of a computer controlled electronic scanner at the central office. The scanner would be capable of rapidly transmitting and receiving data over any subscriber line chosen by the computer. It could switch from line to line at a millisecond rate. Such apparatus would function independently of the regular central office equipment and hence should not interfere at all with normal operations. Multiple units operating in parallel could be used to increase the effective polling rate.

In most cases, only the total vote for each alternative would be recorded, altho if desired, the effect of an open roll call could be obtained by recording in the computer memory how each individual voted. Straw votes involving a random sample of the voters could easily be implemented, with the novel aspect that no individual voter would know whether or not his vote was in the sample.

Problems exist with respect to ensuring that each registered voter be given the opportunity to cast exactly one vote, that no fraudulent votes can be cast, and that, where appropriate, the

secrecy of the ballot is preserved. Solutions exist for each of these problems. The difficulty lies in developing economically feasible techniques.

An approximation to a voice vote, or perhaps applause, might be developed by giving each subscriber a simple device capable of switching a capacitor across his phone line, then momentarily connecting all subscriber lines in parallel at the central office and measuring the total capacitance. Such an operation might be executed in seconds to obtain a quick reading of citizen reaction. This is one of a family of "analog" schemes that will be investigated.

The polling problem for switched cable CTV systems is similar to that for telephone systems as far as physical arrangements are concerned [4,12]. Probably there would be less difficulty in practice since such a capability could be designed into the system at the outset instead of having to retro-fit it into a variety of existing configurations.

In the case of conventional frequency division CTV systems, the situation is significantly different, since thousands of subscribers are connected to the same broadband cable.

Proposed methods [4,12,13] are based on assigning a unique binary coded address to each subscriber on a particular cable. The subscriber votes as in the previous case by pushing buttons on his terminal, which stores the data. This data, modulated for transmission thru a return channel on the cable, is released upon receipt of a signal from a unit at the head end that carries the corresponding subscriber address. Very high speeds are attainable in this manner; a rate of 1000 votes per second would not be difficult to achieve.

The need for a unique adjustment at each station (to give it a unique address) is one weak spot in a frequency division CTV polling system. A second is the "party line" nature of such systems, which complicates the problem of securing privacy and fraud prevention.

On the other hand, the head end equipment can be simpler than that needed in either the telephone or switched cable systems. Furthermore, it is inherently a good deal faster than both of these due to the broader band width available. (It is possible that some schemes could be devised for polling with switched cable systems that would significantly reduce this latter advantage.)

5. Conclusions

Large scale, meaningful citizen participation in government necessitates the development of sophisticated conference and polling facilities utilizing telephone and CTV systems. Preliminary studies indicate that the technology required is within the current state of the art.

Furthermore, it seems reasonable that the necessary equipment additions in the form of home terminals, return channels, and central offices or head end processors can also serve a variety of other functions. The facilities required for polling may find application for such purposes as remote shopping (in conjunction with CTV), burglar alarms, fire alarms, remote meter reading, testing of phone lines, pay TV, and educational TV with student responses. The proposed improved tele-conference facilities would obviously constitute a valuable service for commercial, governmental, educational, and personal use.

Altho not discussed in this report, there are several other features that would be useful in a participatory system. One, which has been widely discussed, and which is already being initiated in a few places, is the provision of an abundance of CTV channels with accompanying regulations that would allow easy access to them by a wide variety of groups and individuals.

For many purposes audio-video conferences in which most participants could be at home viewing and hearing the principal speakers and responding verbally would be very appropriate. This would entail the availability of a large number of CTV channels and the networking of head ends.

Another valuable aid to citizen participation would be an information retrieval system accessible from home terminals and frame grabbing apparatus [12]. The Congressional Record would make an excellent data base for such a system, in that a wide variety of information pertinent to governmental decision making is contained therein, and it is already well indexed.

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